(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 052 378**
A1

(12) EUROPEAN PATENT APPLICATION

(21) Application number: 81109747.6

(22) Date of filing: 17.11.81

(51) Int. Cl.³: B 29 H 5/01
B 29 H 5/24

(30) Priority: 18.11.80 JP 163061/80
24.07.81 JP 116644/81

(43) Date of publication of application:
26.05.82 Bulletin 82/21

(84) Designated Contracting States:
DE FR GB IT

(71) Applicant: SUMITOMO RUBBER INDUSTRIES LIMITED
No. 1-1, Tsutsui-cho 1-chome
Chuo-ku, Kobe-shi Hyogo-shi, Hyogo-ken(JP)

(72) Inventor: Sakon, Tohachiro
15-12, 2-chome, Heiwadai-cho
Nagata-ku Kobe(JP)

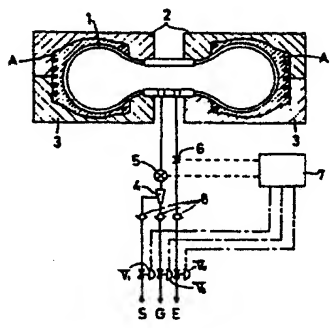
(72) Inventor: Arimatsu, Toshio
8-8, 2-chome, Matsunouchi
Akashi-shi Hyogo(JP)

(74) Representative: Eder, Eugen, Dipl.-Ing.
Patentanwälte Dipl.-Ing. E. Eder Dipl.-Ing. K. Schieschke
Elisabethstrasse 34
D-8000 München 40(DE)

(54) Method for vulcanizing an elastomer.

(57) The invention relates to a method for vulcanizing an elastomer (A), such as tire, fender, sleeve, hose, etc., set in a vulcanizing chamber by use of a mixed fluid comprising a low enthalpy gas (G) and a high thermal capacity thermal fluid (S), said mixed fluid being obtained by preliminarily mixing said gas (G) and said thermal fluid (S) by means of a mixer (4) or by introducing said gas and fluid each independently into the vulcanizing chamber for direct mixing in said vulcanizing chamber, the temperature, pressure and flow rate necessitated for the vulcanization of the vulcanizable elastomer being adaped to be controlled by a temperature sensor (6) and a pressure sensor (5) provided inside or outside the mixer (4) or inside the vulcanizing chamber respectively, thereby enabling to obtain proper vulcanization without the conventional impediments of surface bareness or imperfect adhesion in the part of the carcass due to insufficient exhaust of air.

FIG1



EP 0 052 378 A1

METHOD FOR VULCANIZING AN ELASTOMER

The invention relates to a method for vulcanizing an elastomer, and more particularly to a method for vulcanizing an elastomer set in a vulcanizing chamber by use of a mixture of a high pressure low enthalpy gas and a low pressure high thermal capacity thermal fluid.

Elastomers have heretofore been vulcanized by various methods. Particularly, the so-called gas vulcanization method was proposed in Patent Laying-Open Gazette No. SHO-51-64579.

According to the method, a vulcanizable elastomer placed in a vulcanizing chamber is subjected to a first and a second processes, in the first process the elastomer being hardened by supplying a relatively low pressure high thermal capacity thermal fluid, for example, steam, in the second process the vulcanization of said elastomer being completed by introducing a low enthalpy gas of higher pressure than that of said thermal fluid.

This method, however, has a disadvantage in that fully satisfactory hardening is not obtainable since there is a limit to the control of the pressure and temperature of the relatively low pressure high thermal capacity thermal fluid supplied in the first process for hardening the elastomer.

To be more precise, since saturated steam is generally used as a high thermal capacity fluid, the conventional method has the following disadvantages due to proportional interrelation existing between the temperature and the pressure.

(1) If the temperature is held proper, the pressure is

excessively reduced thereby making it impossible to satisfactorily exhaust the air accumulated between the metal molds and the elastomer to be vulcanized. Thus there is a tendency that bareness arises on the surface of the vulcanized elastomer and imperfect adhesion occurs in the part of the carcass.

(2) If the pressure is held proper, the temperature is excessively elevated. Thus the elastomer is over-vulcanized resulting in deterioration of rubber or cord.

The present invention has been made as a result of a series of tests to eliminate the above-described difficulties involved in the conventional method of gas vulcanization. The invention enables to obtain proper vulcanization without surface bareness at low cost by means of a mixture of a low enthalpy gas and high thermal capacity thermal fluid, e.g., steam, controlled to an optional temperature and pressure.

The invention will hereinunder be described in detail in reference to the accompanying drawings.

Fig.1 is a diagram showing an embodiment of the vulcanization method according to the invention, wherein a tire (A) is used as an example of vulcanizable elastomers. Fig.1 shows the state in which vulcanization of said tire (A) set in the vulcanizing chamber or metal molds with interposition of a bladder has made a considerable progress. Fig.2 is a longitudinal sectional view of an ejector which is a mixer. Fig.3 is a diagram showing another embodiment of the vulcanization method according to the invention. Fig.4 is a diagram showing a still further embodiment of the vulcanization method according to the invention.

Referring to Fig.1, the numeral 1 designates a bladder with its outer periphery inflated by the supply of fluid, 2 designating an upper metal mold, 3 designating a lower metal mold. The tire (A) is interposed between the bladder 1 and the metal molds 2,3. The numeral 4 designates a mixer, the mixer 4 being adapted to receive steam (S) and gas (G), the mixed fluid being supplied to the bladder 1 in the vulcanizing chamber. The numeral 5 designates a pressure sensor, 6 designating a temperature sensor, 7 designating a controller with a microcomputer incorporated therein. The numeral 8 designates a check valve, V_1,V_2,V_3 designating automatic control valves provided in the pipes of the steam (S), gas (G) and exhaust (E), respectively.

The controller 7 is adapted to detect the pressure by the pressure sensor 5 in the supply route of the mixed fluid supplied to the vulcanizing chamber from the mixer and the temperature by the temperature sensor 6 in the discharge route of the exhaust gas (E). In the controller 7 there are preliminarily stored the conditions of proper pressure and temperature so that the flow rate of the steam and gas to the mixer can be controlled and the mixed fluid can be discharged by operating the automatic control valves respectively thereby enabling to supply mixed fluid of required pressure and temperature to the vulcanizing chamber. The pressure sensor 5 and the temperature sensor 6 for detecting the pressure and temperature respectively may be provided inside the mixer 4 as shown in Fig.3. The vulcanization method shown in Fig.3 is same as in the case of Fig.1.

The invention will hereinunder be described in more detail in reference to the case in which the vulcanizable elastomer is, for example, a tire of the size

of 1000-20.

The conditions of vulcanizing a tire of the size of 1000-20 are within the scope of the temperature 140-200°C and the pressure 15-30 kg/cm^2. For example, the conditions of 170°C and 28 kg/cm^2 are preliminarily stored in the controller 7, a raw tire being set in the metal molds, the automatic control valves V_1,V_2 being opened while the automatic control valve V_3 is closed, thereby supplying the steam (S) and gas (G) to the mixer 4.

The mixed fluid mixed in the mixer is supplied into the metal molds. Thus the vulcanization starts. In course of the heat treatment by means of said mixed fluid, the pressure and temperature of the mixed fluid are continuously entered as inputs into the controller thereby enabling said controller to control the apertures of the automatic control valves of the steam and gas V_1, V_2 in conformity with said conditions of 170°C-28 kg/cm^2.

The control in case of excess or deficiency of the pressure and temperature of the mixed fluid is effected as follows. If the temperature alone is short of the standard level, the valves V_1,V_2 and V_3 are opened, while if the pressure is higher than the standard level and the temperature is short of the standard level, the valve V_3 is first opened to discharge the mixed fluid, said valve V being subsequently closed, the valves V_1,V_2 being then opened thereby supplying the steam and the gas.

If the pressure alone is short of the standard level, the valve V_2 is opened with the valves V_1,V_3 remaining closed so that the gas may be supplied to the mixer in large amount.

In the invention, no particular limitation is placed on the mixer 4 for use in mixing the steam and the gas. The mixer may be, for example, an ejector as shown in Fig.2 in which gas (G) is introduced through (11), steam (S) supplied through (12) being sucked by the gas pressure, the mixed fluid (G & S) being jetted through the discharge port 13.

The vulcanization (the vulcanizing process) of the tire is completed by supplying thereto a mixed fluid of the aforesaid conditions for 40-50 minutes.

The same is applicable to the case in which vulcanization is effected without interposition of the bladder.

Another embodiment of the invention will now be described in detail in reference to Fig.4. In this embodiment, a low pressure high thermal capacity thermal fluid and a high pressure low enthalpy gas are mixed directly in the vulcanizing chamber (or in the bladder or elastomer) without using the mixer, a mixed fluid of optional temperature and pressure being obtained by detecting the temperature and pressure by means of a temperature sensor and a pressure sensor provided in the vulcanizing chamber respectively. Vulcanization is effected by obtaining a proper mixed fluid in the bladder (or in the elastomer) in the same manner as described relative to Fig.1 by use of the pressure sensor 5, temperature sensor 6, controller 7 and automatic control valves V_1, V_2, V_3.

After the heat treatment, the automatic control valve V_3 communicating with the exhaust port is opened, while the steam and gas control valves V_1, V_2 are closed, so as to discharge the mixed fluid. Thus the heat treatment is completed.

The whole vulcanizing process is completed through the conventionally known steps, such as water cooling process and the like.

The elastomers vulcanizable by the method according to the invention comprise fenders, sleeves, hoses, etc., in addition to tires described in the embodiment of the invention.

As described hereinbefore, the vulcanization method according to the invention is characterized in that a mixed fluid of steam and gas preliminarily blended by a mixer provided outside the vulcanizing chamber is supplied into said chamber or steam and gas independently supplied to the vulcanizing chamber are mixed directly in said chamber, a controller with a microcomputer incorporated therein being used in order to set and continuously maintain the mixed fluid at the pressure and temperature conditions most suitable for vulcanization thereby enabling to obtain high pressure without permitting the temperature to rise in excess in the initial stage of vulcanization of the elastomer. Thus the invention enables to obviate surface bareness due to excess or deficiency of pressure and temperature and overvulcanization resulting in deterioration of rubber and cord.

The invention has a further advantage in that the waste of energy can be prevented since the thermal value is continuously controlled in conformity with the predetermined conditions.

Claims:

1. A method for vulcanizing an elastomer (A) set in a vulcanizing chamber by use of a mixture of a high pressure low enthalpy gas (G) and a low pressure high thermal capacity fluid (S), characterized in that said gas (G) and thermal fluid (S) are preliminarily mixed in a mixer (4).

2. A method for vulcanizing an elastomer as defined in claim 1 characterized in that the mixed fluid is controlled to an optional temperature and pressure in conformity with signals from a temperature sensor (6) and a pressure sensor (5) provided inside or outside the mixer 4 respectively.

3. A method for vulcanizing an elastomer (A) set in a vulcanizing chamber by use of a mixture of a high pressure low enthalpy gas (G) and a low pressure high thermal capacity thermal fluid (S), characterized in that said gas (G) and fluid (S) are mixed inside said vulcanizing chamber after being supplied each independently into said vulcanizing chamber.

4. A method for vulcanizing an elastomer as defined in claim 3 characterized in that the mixed fluid is controlled to an optional temperature and pressure in conformity with signals from a temperature sensor (6) and a pressure sensor (5) provided in the vulcanizing chamber respectively.

FIG 1

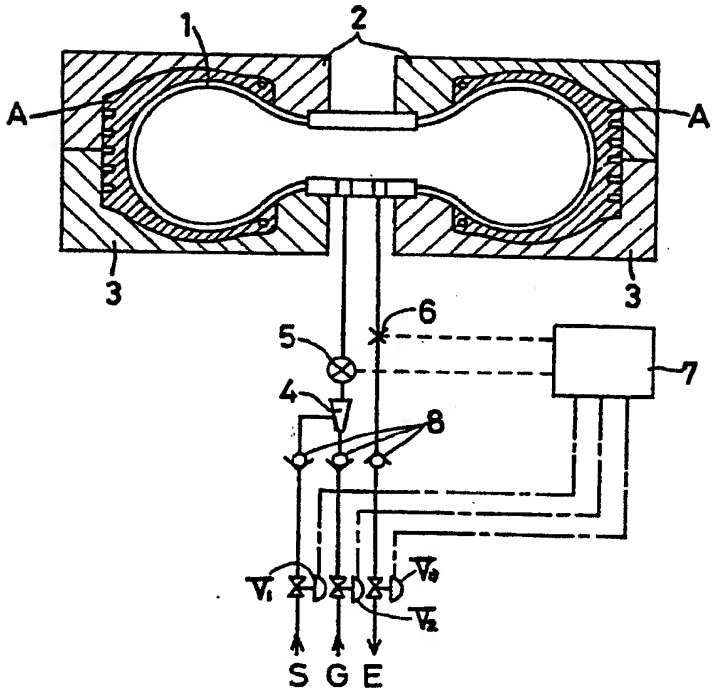
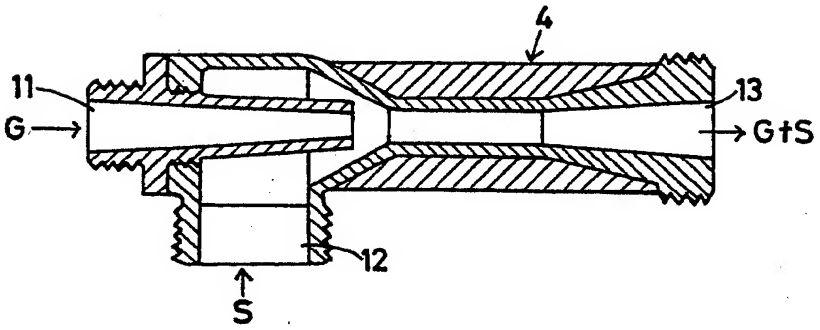


FIG 2



2/2

FIG 3

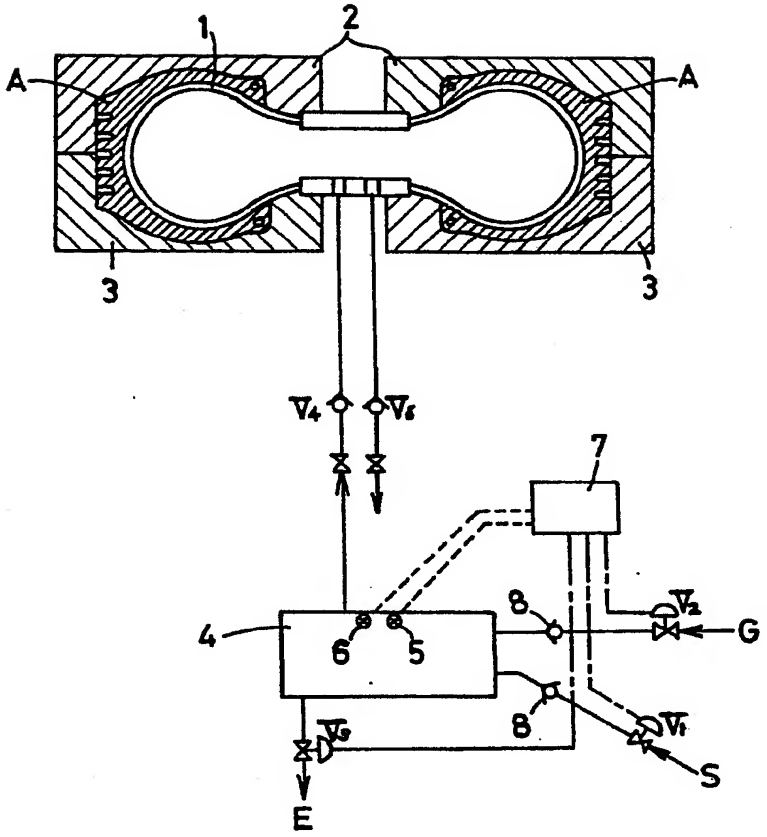
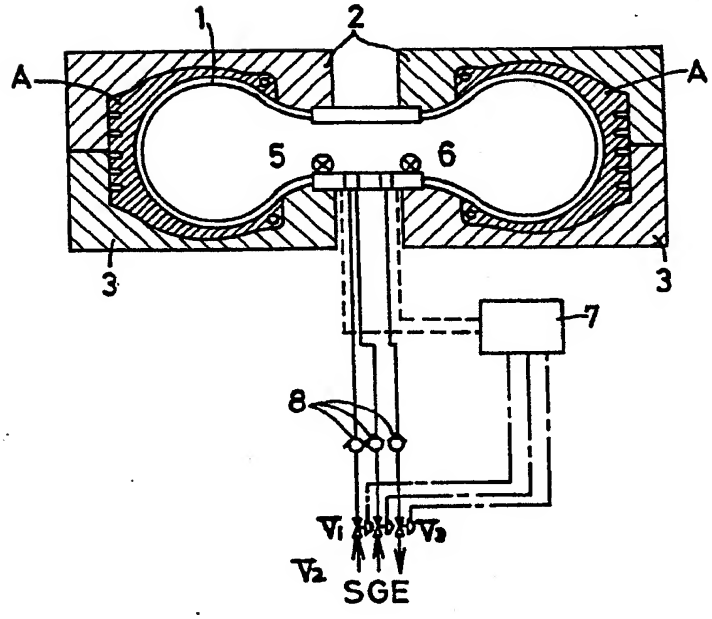


FIG 4



European Patent Office

EUROPEAN SEARCH REPORT

Application number
EP 81 10 9747

DOCUMENTS CONSIDERED TO BE RELEVANT			CLASSIFICATION OF THE APPLICATION (Int. Cl. ³)
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	
D/X/Y	GB - A - 1 501 943 (GATES RUBBER) * page 2, line 120 to page 3, line 72; page 4, lines 72-105 * & JP - A - 51/064579	1,3,4	B 29 H 5/01 B 29 H 5/24
Y	GB - A - 1 285 246 (COMPAGNIE LYONNAISE DE GENIE CHIMIQUE P. LACOLLONGE) * page 3, lines 50-75 *	1	
A	US - A - 1 808 429 (H. MINOR)		TECHNICAL FIELDS SEARCHED (Int.Cl.³)
A	GB - A - 339 303 (INDUSTRIAL PROCESS CORPORATION)		B 29 H 5/01 B 29 H 5/24
A	FR - A - 2 265 529 (GOODYEAR) & US - A - 3 942 922		

CATEGORY OF CITED DOCUMENTS

X: particularly relevant if taken alone
Y: particularly relevant if combined with another document of the same category
A: technological background
O: non-written disclosure
P: intermediate document
T: theory or principle underlying the invention
E: earlier patent document, but published on, or after the filing date
D: document cited in the application
L: document cited for other reasons

&: member of the same patent family, corresponding document

X The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	27.01.1982	SCHMITT

EPO Form 1503.1 06.78